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REPORT DOCUMENTATION PAGE

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1. REPORT NUMBER TOP 6-2-551	2. GOVT ACCESSION NO. AD A092271	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) US ARMY TEST AND EVALUATION COMMAND TEST OPERATIONS PROCEDURE RADIAC RATEMETER CALIBRATION ACCURACY		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s)		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS US ARMY ELECTRONIC PROVING GROUND (STEEP-MT-T) FORT HUACHUCA, ARIZONA 85613		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS DARCOM-R 310-6
11. CONTROLLING OFFICE NAME AND ADDRESS US ARMY TEST AND EVALUATION COMMAND (DRSTE-AD-M) ABERDEEN PROVING GROUND, MARYLAND 21005		12. REPORT DATE 29 October 1980 13. NUMBER OF PAGES 9
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

This TOP complements Materiel Test Procedure MTP-6-3-335, 15 January 1971, which remains in effect.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Radiation: Ionizing, Neutron, Particulate, and X-Ray.
Dependence: Directional, Energy. Meters: Dosimeter, Ratemeter.
Response Time: Drift, Warm-up.
Sources: Co 60, Cs 137, Sr/Yt-90, Pu-239, X-Ray

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This is a procedure to standardize methods of determining the calibration accuracy of ratemeters over the range of 80 KEV to 3 MEV. It is to be conducted within a secure enclosure or building where radiation is reduced to a rate less than 2 milliroentgens per hour. Calibration is scored against US Army secondary standards. The procedure is used for/with tactical ratemeters.

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US ARMY TEST AND EVALUATION COMMAND
TEST OPERATIONS PROCEDURE

DRSTE-RP-702-105
Test Operations Procedure 6-2-551
AD No. A092271

29 October 1980

RADIAC RATEMETER CALIBRATION ACCURACY

1. SCOPE

1.1 The objective of this Test Operations Procedure (TOP) is to standardize methods for determining the calibration accuracy of ratemeters used for measurements of radiation of prescribred energies, e.g., 80 KEV to 3 MEV. This TOP considers only secondary standards calibrated under controlled laboratory conditions. Field calibrators are not considered.

2. FACILITIES AND INSTRUMENTATION

2.1 Facilities. A physically secure enclosure or building by which the ionizing radiation, within, is reduced to a rate less than or equal to 2 milliroentgens per hour at the established safety perimeter, in order to comply with all local, state, and federal regulations at the time of testing.

2.2 Instrumentation

ITEM	ACCURACY
SECONDARY STANDARDS	
e.g., AN/UDM-1, AN/UDM-1A, J.L.S. MDL-138, M3A1. [Based on NBS standards)	Corrected to within ±3 percent (with source correction factors applied).
Radiation Measuring Devices e.g., Condenser "R" meter.	±2 percent of full scale.

ITEM	ACCURACY
SECONDARY STANDARDS	
Warning Devices (Visual/Audio)	Sensitive to 2 mR/hr.
Optical Support Equipment	
Voltmeter, Range 1, 10, 100, 1000 Vdc	±2 percent full scale
Photodosimetry Film Badge	
Pocket Dosimeter (0-200 mR)	
Radiacmeters	
Thermometer °F or °C	±1/2°F or 1/4°C.
Barometer	To 1/100 in. Hg or 1/10mm Hg.
Necessary tools	

3. PREPARATION FOR TEST

3.1 Facilities. Ensure facilities conform to minimum requirements, and that all safety alarms and controls are operating.

3.2 Equipment. Select Radiation Measuring Devices (RMD) having an accuracy of at least one order of magnitude greater than that of the test item. Calibrations shall be traceable to National Bureau of Standards (NBS).

3.3 Personnel. Ensure that all calibration personnel are familiar with the technical and operational characteristics of the item being calibrated and the operational and safety requirements applicable to the radioactive source being used. A briefing on the hazards and safety precautions is necessary.

3.4 Instrumentation. Set up and check all instrumentation in accordance with technical manuals, technical bulletins, or manufacturer's specifications applicable to the radioactive source used and the unit under calibration.

3.5 Data Required. Record the following: (See Section 5.2.4)

3.5.1 Test Item. Type number, serial number, nomenclature, and manufacturer's name.

3.5.2 Instrumentation. List the type, model, serial number, manufacturer, and date of last calibration for each instrument used.

3.5.3 Personnel Data. Technician's name, grade, and MOS/series if applicable, and film/dosimeter serial numbers. Also record daily and total doses as registered by the dosimeters.

4. TEST CONTROLS

4.1 Set up the source, instrument under calibration, radiation measuring devices, and warning devices inside the secure area.

4.2 Set up the optical support equipment to facilitate observation of the indicator of the unit under test.

4.3 Calibration personnel will wear the assigned photodosimetry film badge, pocket dosimeters, and "tattler" detectors while working in the radiation area.

4.4 Ensure that security measures are enforced so that no unauthorized personnel may enter the radiation area while the sources are in an exposed condition.

4.5 Inspect the instrument under test/calibration carefully for physical and electrical defects and check the condition of the self-contained batteries.

4.5.1 Perform all precalibration checks in accordance with the operations manual.

4.5.2 Note, record, and correct all defects before proceeding with the test.

5. PERFORMANCE TESTS

5.1 Test Preparation.

5.1.1 Use the source correction, factor, table, and positiong charts to ascertain the distance between the source and the instrument under test necessary to expose the instrument to selected dose rates, e.g., 1, 5, 10, 100, 200, 500 rads (or millirads) per hour.

5.1.2 Place the positioning carriage the distance from the source ascertained in paragraph 5.1.1 above.

5.1.3 Place the instrument under test on the carriage, positioned and oriented as shown in the applicable source T.M.

5.1.4 Set up the associated optics system when required so that the indicator of the instrument under calibration may be clearly observed.

5.1.5 Turn on the test item under test and all associated instrumentation, and allow sufficient time for thermal equilibrium to be attained.

5.1.6 Set the instrument under test to zero.

5.2 Performance

5.2.1 Expose the unit under test to radiation and observe the reading(s) obtained.

5.2.2 Check/calibrate the unit under test for accuracy.

5.2.3 Ascertain if the calibrated reading(s) are within the specified tolerance.

5.2.4 Record the following:

a. Source(s) used.

b. Selected dose rates to which the test item was exposed.

c. Results of reading(s) on calibrated meter scale for each level of radiation used.

d. Any instability or erratic behavior of instrument under test.

e. The dose rates on two points of each scale for dose rate instruments used to determine time of stay and exposure estimates. (Paragraph 29c, AMCR 385-25).

6. DATA REDUCTION AND PRESENTATION

6.1 Present the data in tabular or graphical form showing readings obtained versus "true" rates.

6.2 Show the percent difference limits to allow direct comparison of values and criteria.

6.3 Review the data to determine if the unit under test meets the specified accuracy.

6.4 Note the test item specifications on the test data presentation to facilitate analysis and comparison.

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APPENDIX A

CHECKLIST

RADIAC CALIBRATION ACCURACY

Check and initial when complete.

Facility conforms to minimum requirements (para 2.1)	________________.
Instrumentation in calibration (para 2.2)	________________.
Test item's basic data recorded (para 3.5.1)	________________.
Instrumentation data recorded (para 3.5.2)	________________.
Name, grade and MOS of person taking data recorded (para 3.5.3)	________________.
Dosimeters and film badges - all personnel (para 4.3)	________________.
Security measures instituted (para 4.4)	________________.
Precalibration checks performed (para4.5)	________________.
Thermal equilibrium obtained (para 5.1.5)	________________.
Test item test data recorded (para 5.2.4)	________________.
Data reduced (para 6)	________________.
Personnel daily dosimeter readings recorded	________________.

APPENDIX B

SAMPLE FORM FOR RADIAC CALIBRATION ACCURACY DATA COLLECTION AND TEST DATA COMPILATION

DOSIMETER: (TEST ITEM)

Type Number ________ Serial Number ________ Nomencalutre ________ Manufacturer ________

Instrumentation	Type/Model No.	Serial No.	Nomenclature	Manufacturer	Calibration Date

Pre-Cal Chk.	Basic Accuracy
Mechanical ________	Dose Rate ________
Battery ________	Meter Reading ________
Barometric Press:	Dose Rate ________
________ mm/inches	Meter Reading ________
Temperature:	Dose Rate ________
________ °F ________ °C	Meter Reading ________

Data Taken By ________ Grade ________ MOS/Series ________
Film Badge, S/N ________ Dosimeter S/N ________

APPENDIX C

SUPPLEMENTAL NOTES AND INFORMATION

NOTE 1. To completely define and determine Ratemeter Calibration Accuracy it is necessary to make additional measurements such as Beta Detection; Rate, Energy, and Directional Dependence; Energy and Type Discrimination; and Response/Linearity. Additional TOPS may be prepared for those measurements.

NOTE 2. PROCEDURE FOR CONTROLLING RADIOACTIVTE POLLUTANTS OR/OF NUCLIDES USED IN TESTING RADIAC EQUIPMENT

Introduction:

In order to accomplish the mission of testing RADIAC* equipment, wherein dangerous ionizing radiations must be used and controlled, special structures must be installed in the radiation area. The radiation area, to include cement barrier, locking gates, storage area, protected operator positions, fenced and roped areas, perimeter fence and designated radiation lines, etc., must be planned and constructed in accordance with AMCR 385-25. This regulation fixes the responsibilities on the commander of installations and activities that procure, receive, store, ship, use, transport, maintain, or dispose of sources of radiation. Also, the commander must establish a formal, written radiation safety program; appoint a qualified individual as radiological protection officer, (AR 40-14), and an alternate to provide continuity of operations; and assure compliance with federal, state, and local regulations.

The radiological Protection Officer (RPO), licensed by the NRC has complete control of the radiation area and is responsible for compliance with all regulations involving ionizing material and personnel in the radiation area. He is the individual designated by the commander to provide consultation on the degree of hazards associated with ionizing radiation and on the effectiveness of measures to control these hazards. This individual shall be technically qualified by virtue of education, military training and/or professional experience to assure a capability commensurate with the assignment. The term "Radiological Protection Officer" is a functional title and is not intended to denote a commissioned status or job classification within the Armed Forces. Basic Radiological Health courses given by the US Department of Health, Education and Welfare, and also the US Army Environmental Hygiene Agency, Edgewood Area, Aberdeen Proving Ground, Maryland 21010, are taken by this individual prior to appointment or as soon thereafter as possible.

All radioactive sources are sealed. A RADIAC facility Standing Operating Procedure (SOP) must be prepared in accordance with safety guidelines to assure safe procedures while using the radioactive sources. The SOP is tailored to the facility. The source is contained in an enclosure which has a shield toward the operator and a gate which may be opened on the opposite side. When the sealed source shield is lifted at the opening, the beam faces the item

*RADIAC: Radioactivity Detection, Identification, and Computation.

under test and the VAMP sensors, (warning device). The warning device emits a 62 dB sound level intermittent signal when exposed to radiation as a reminder to all personnel in the area. The operator temporarily is on a line designated as the 5 mR/hour radiation level lines. While the source is in use, the operator moves back to an area whose radiation level is less than 2 mR/hour. On the other side of the cement barrier, where the radiation beam is directed, the radiation level reading should be less than 0.5 mR/hour.

The requirements that must be met in building and maintaining a radiation area compound are rigid and require constant periodic surveillance and control. The sealed sources and the radiation level lines must have their integrity assured on a periodic basis. As a result of the above requirements, it is evident that the use of effective procedures, methods, tehcniques, and instrumentation are of paramount importance. Occupational Health and Environmental Control subpart G 1910.96, Ionizing Radiation, Title 29 of the Code of Federal Regulations are the stanards, rules, and regulations to be used and followed.

Operating Procedures:

A. General Safety. Monthly radiation surveys at various points within the radiation area are performed to assure safety. A High Energy Portable Health Exposure Measuring System is used to determine the radiation in the areas of interest. It provides continuous indication of exposure rates over an extremely wide and adequate range, including a broad gamma energy range. Its exposure integration feature permits accumulation of total exposure. The instrument configuration is ideal for table-top measurement of flux surveys of alpha, beta, gamma, and x-ray raidation. A Low Energy Survey Meter may be used which provides broad energy response to gamma and x-radiations, and sensitivity to beta and alpha. Exposure rate is read out directly in milliroentgens per hour (mR/hr). A neutron detector is used to monitor the Pu Be neutron howitzer source.

B. Operational Checks. When a sealed source is brought out and placed in the fixed operation position, the high level meter is used to measure and locate the designated radiation level lines, (5 mR/hr), and the edge of the radiation beam, (100 mR/hr), when the source hatch has been turned on. When the radioactive source is still sealed, (turned off), the operator places the test item to be tested in the maximum field area that the source will produce when "turned on." The RADIAC instrument to be tested is adjusted so that the meter reading can be seen by a TV camera and monitor or telesope at the operator's shielded position. Operators wear film badges and pocket dosimeters to determine total exposure. The film badges are checked officially by the Lexington Army depot. Swipe tests are taken as per instructions in the regulations and techniques in TECOM Pamphlet Number 385-2. Swipes, also referred to as smears or wipes, are pieces of paper, cloth, or cotton used to wipe the surface of work areas, personnel, vehicles, tools, or equipment. Swipes are taken to detect the presence of removable contamination for the purpose of preventing or controlling the spread of radioactive material to clean areas. Otherwise, this previously clean area would further pollute and contaminate more personnel and equipment.

C. Calibration and standard radioactive nuclide sources such as the AN/UDM-1 (Co 60), AN/UDM-1A (cs 137) and model 179 Neutron Howitzer are typical radioactive nuclides used in the above procedures.

In order to survey an area where radioactive nuclides emit neutrons, a neutron survey meter must be used. The neutron detector or survey meter must be different from other detectors because the neutron has no charge, positive or negative. The secondary ionization produced by thermal neutrons activates the detector. The neutron detector contains a gas which readily captures neutrons, forming ions, which enter the detection stage of the instrument. The fast neutrons must be slowed down or thermalized by moderators such as paraffin to be detected. A neutron survey meter provides a fast and thermal neutron survey capability. The removable shield and moderator enclose a neutron proportional detector for fast neutron monitoring.